# 299-E33-71 (A6879)

## Log Data Report
(REVISED)

## Borehole Information:

| Borehole: | 299-E33-71 (A6879) | | Site: | 216-B-8 Crib | |
|---|---|---|---|---|---|
| Coordinates (WA State Plane) | | GWL (ft)[1]: | see Borehole Notes | GWL Date: | 9/01 |
| North (m) | East (m) | Drill Date | TOC[2] Elevation | Total Depth (ft) | Type |
| 137471.504 | 573780.678 | Dec. 1947 | 643.71 ft | 150 | |

## Casing Information:

| Casing Type | Stickup (ft) | Outer Diameter (in.) | Inside Diameter (in.) | Thickness (in.) | Top (ft) | Bottom (ft) |
|---|---|---|---|---|---|---|
| Steel | 2.73 | 8.625 | 8.0 | 0.3125 | 0 | 146 |

## Borehole Notes:

The borehole was swabbed before collecting data, and water was detected inside the casing at 115.4 ft. It is not known if this water is perched or is surface water that has accumulated inside of the casing.

The casing depth is derived from *Hanford Wells* (Chamness and Merz 1993). The logging engineer measured the pipe stickup at the borehole using a steel tape. Calipers were used to measure casing outside diameter and thickness; the casing inside diameter is calculated. Coordinates and TOC elevation are derived from HWIS[4].

## Logging Equipment Information:

| Logging System: | Gamma 2B | | Type: SGLS (35%) |
|---|---|---|---|
| Calibration Date: | 09/00 | Calibration Reference: | GJO-2001-245-TAR |
| | | Logging Procedure: | MAC-HGLP 1.6.5 |

| Logging System: | Gamma 1D | | Type: SGLS (35%) |
|---|---|---|---|
| Calibration Date: | 07/01 | Calibration Reference: | GJO-2001-243-TAR |
| | | Logging Procedure: | MAC-HGLP 1.6.5 |

## Spectral Gamma Logging System (SGLS) Log Run Information:

| Log Run | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Date | 09/19/01 | 10/02/01 | 10/03/01 | 10/03/01 | |
| Logging Engineer | Musial | Musial | Musial | Musial | |
| Start Depth (ft) | 3.0 | 69.0 | 97.0 | 75.0 | |
| Finish Depth (ft) | 70.5 | 98.5 | 115.0 | 87.0 | |
| Count Time (sec) | 100 | 100 | 100 | 100 | |
| Live/Real | R | R | R | R | |
| Shield (Y/N) | N | N | N | N | |
| MSA Interval (ft) | 0.5 | 0.5 | 0.5 | 0.5 | |
| ft/min | n/a[3] | n/a | n/a | n/a | |

| Log Run | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Pre-Verification | B0055CAB | A0006CAB | A0007CAB | A0007CAB | |
| Start File | B0055000 | A0006000 | A0007000 | A0007037 | |
| Finish File | B0055136 | A0006060 | A0007036 | A0007061 | |
| Post-Verification | B0055CAA | A0006CAA | A0007CAA | A0007CAA | |
| Depth Return Error (in.) | 0 | 2.4 | 0 | 0 | |
| Comments | Gamma 2B | Gamma 1D | Gamma 1D | Gamma 1D Repeat Section | |

## High Rate Logging System (HRLS) Log Run Information:

| Log Run | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Date | 02/27/02 | 02/27/02 | | | |
| Logging Engineer | Kos | Kos | | | |
| Start Depth (ft) | 31.0 | 75.0 | | | |
| Finish Depth (ft) | 38.0 | 83.0 | | | |
| Count Time (sec) | 300 | 300 | | | |
| Live/Real | L | L | | | |
| Shield (Y/N) | N | N | | | |
| MSA Interval (ft) | 0.5 | 0.5 | | | |
| ft/min | n/a | n/a | | | |
| Pre-Verification | D0015CAB | D0015CAB | | | |
| Start File | D0016000 | D0016015 | | | |
| Finish File | D0016014 | D0016031 | | | |
| Post-Verification | D0016CAA | D0016CAA | | | |
| Depth Return Error (in.) | None | -0.5 | | | |
| Comments | Gamma 1C | Gamma 1C | | | |

## Logging Operation Notes:

SGLS and HRLS logging were performed during October 2001 and February 2002, respectively. The reference depth for logging measurements is the TOC. The SGLS Gamma 2B was used for the first logging run. Subsequent logging runs used logging system Gamma 1D because of equipment breakdown of logging system Gamma 2B. The HRLS was utilized to perform logging in high gamma flux zones, generally where SGLS dead time exceeded 40 percent. A data repeat section was collected in this borehole with the SGLS to measure the system's performance.

The logging engineer was unable to shell out of the log program to capture file B0055CAB for analysis before logging run 1. High dead time was encountered from about 30 to 37.5 ft during logging run 1. During collection of file B0055CAA, wind blew over tool/verifier. During logging run 2, dead time was more than 50% from approximately 76.5 to 82 ft.

## Analysis Notes:

| Analyst: | SS/PH | Date: | 03/14/02 | Reference: | MAC-VZCP 1.7.9, Rev. 2 |
|---|---|---|---|---|---|

This Log Data Report is a revision of the report originally issued 01/11/02. This revision includes high rate data analysis results that were not previously reported and replaces the original Log Data Report.

Pre-run and post-run verification spectra for the SGLS were evaluated. All of the Gamma 2B spectra were within the control limits. The post-survey verification (file B0055CAA) was outside of the warning limits. The counts per second for the 609-keV photopeak were above the upper warning limits for this post-run

verification spectrum. The verifier and sonde blew over while this spectrum was being acquired, which may have caused the failure of this verification spectrum. The acceptance criteria for field verification of the Gamma 1D logging system were in the process of being established. Examinations of spectra indicate that the detector appears to have functioned normally during the log runs, and the log data are provisionally accepted, subject to further review and analysis. The HRLS passed acceptance criteria.

A casing correction for 0.3125-in.-thick casing is applied to the nominal 8-in. casing.

Individual spectra were processed in batch mode using APTEC Supervisor to identify individual energy peaks and determine count rates. Concentrations were calculated in EXCEL, using an efficiency function and corrections for casing and dead time determined in calibrations of the individual logging systems. EXCEL templates G1d.xls, G2b.xls, and G1cFeb02.xls were used to process data from the SGLSs and the HRLS, respectively. Dead time corrections are applied to log data, including the total gamma data, where the dead time is in excess of 10.5 percent. In zones of high SGLS dead time (> 40%), maximum total gamma count rates and radionuclide concentrations are not considered reliable, and actual values may be higher than reported values. The HRLS is utilized in zones of high SGLS dead times to quantify the $^{137}$Cs concentrations. A correction for water in the borehole was not applied.

The $^{214}$Bi peak at 1764 keV was used to determine the naturally occurring $^{238}$U concentrations rather than the $^{214}$Bi peak at 609 keV. The higher energy 1764-keV energy peak exhibits slightly better count rates than the 609-keV peak because of less gamma attenuation caused by the casing in the borehole. In addition, the 609-keV peak cannot be distinguished as a result of interference from the $^{137}$Cs peak at 662 keV in higher concentration zones.

## Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides ($^{40}$K, $^{238}$U, and $^{232}$Th [KUT]), and $^{137}$Cs. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation and a repeat section is included to demonstrate logging system performance.

## Results and Interpretations:

$^{137}$Cs, which is a man-made radionuclide, was detected almost continually throughout the logged portion of this borehole. A zone of $^{137}$Cs contamination was detected near the ground surface (log depth 3.0 through 11.0 ft) with activities ranging from 0.2 to 178.5 pCi/g. $^{137}$Cs was also measured between 29.5 and 115.0 ft. In this interval, activities exceeded 1,000 pCi/g in the intervals between 31.5 and 38.0 ft, 76.0 and 91.0 ft, and 95.5 and 96.5 ft. SGLS dead times exceeded 40% between 31 and 38 ft and between 75 and 83 ft. HRLS data were collected and substituted for the SGLS data at these depths. The maximum $^{137}$Cs concentration measured about 20,000 pCi/g at 33 ft in depth.

Above the zones of intense gamma-ray activity, apparent $^{40}$K activities are about 12 to 15 pCi/g. Within the zones of intense gamma-ray activity, apparent $^{40}$K activities are about 16 to 20 pCi/g. The relatively high concentrations of $^{137}$Cs below about 30 ft may correspond with the increase in $^{40}$K activities and the transition from the coarse-grained sediments of the Hanford H1 to the finer grained sediments of the Hanford H2.

The repeat log data (75 to 87 ft) were collected in an interval of high dead time. Despite being run in a zone of high activity, the rerun of the natural radionuclides, $^{40}$K and $^{232}$Th, showed good repeatability. Discernable 609-keV photopeaks for $^{238}$U were obscured by the high $^{137}$Cs activity. The $^{137}$Cs

concentrations in this high dead time interval did not repeat because the data in high dead time zones are not reliable because of pulse pileup and speak spreading; therefore, no log plot is included.

## References:

Chamness, M.A. and J.K. Merz, 1993. *Hanford Wells*, PNL-8800, prepared by Pacific Northwest Laboratory for the U.S. Department of Energy.

[1] GWL – groundwater level
[2] TOC – top of casing
[3] n/a – not applicable
[4] HWIS – Hanford Well Information System

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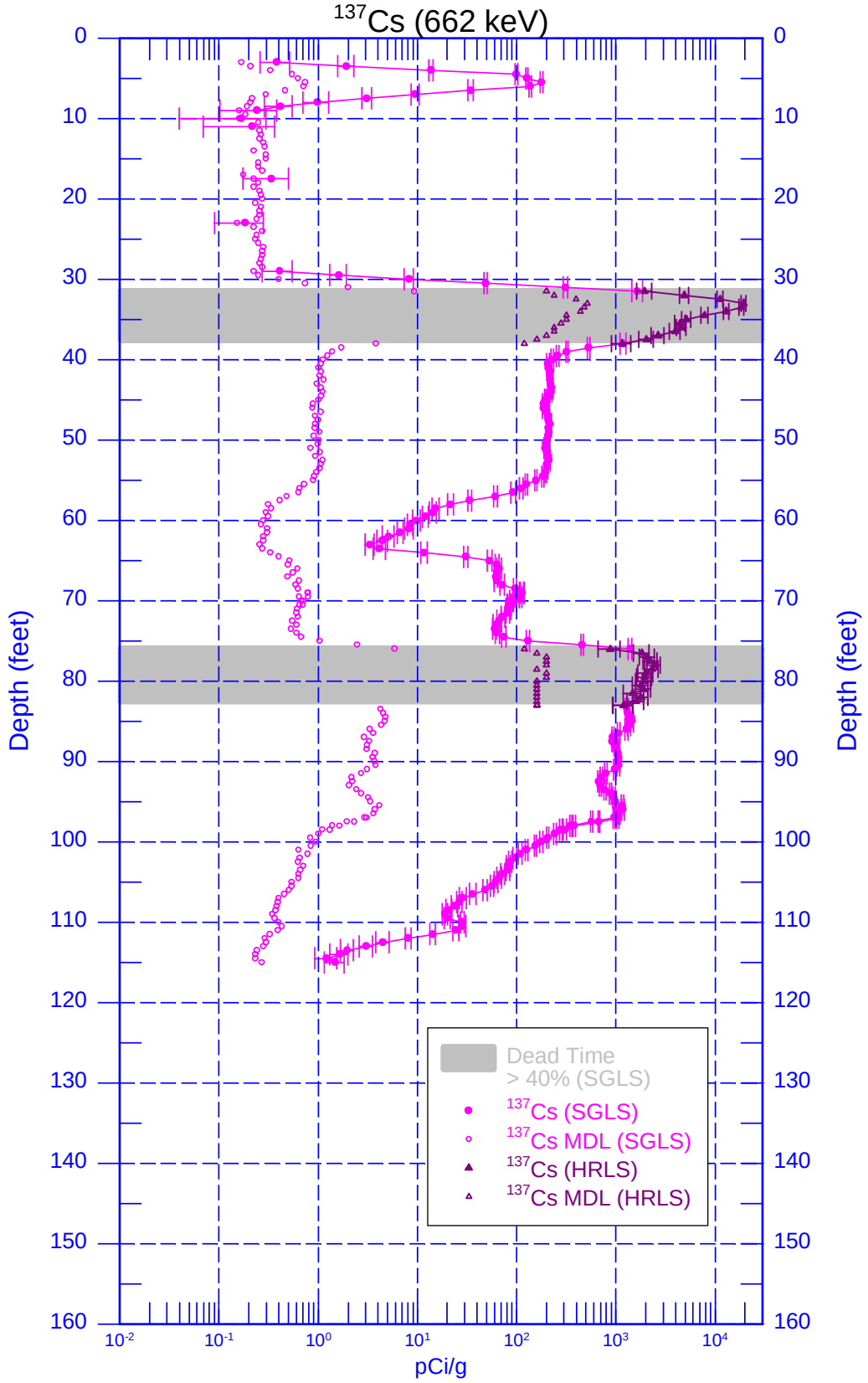
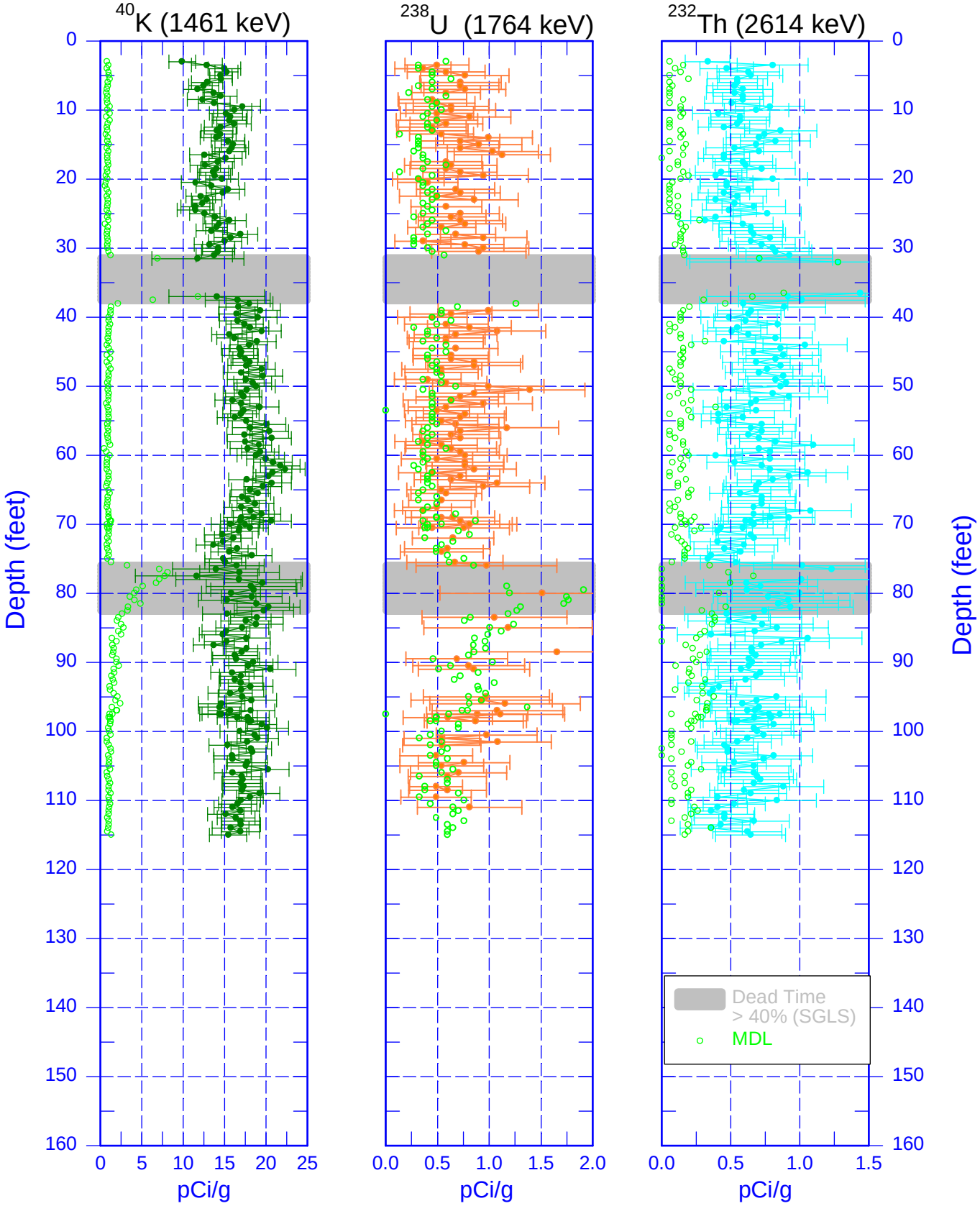
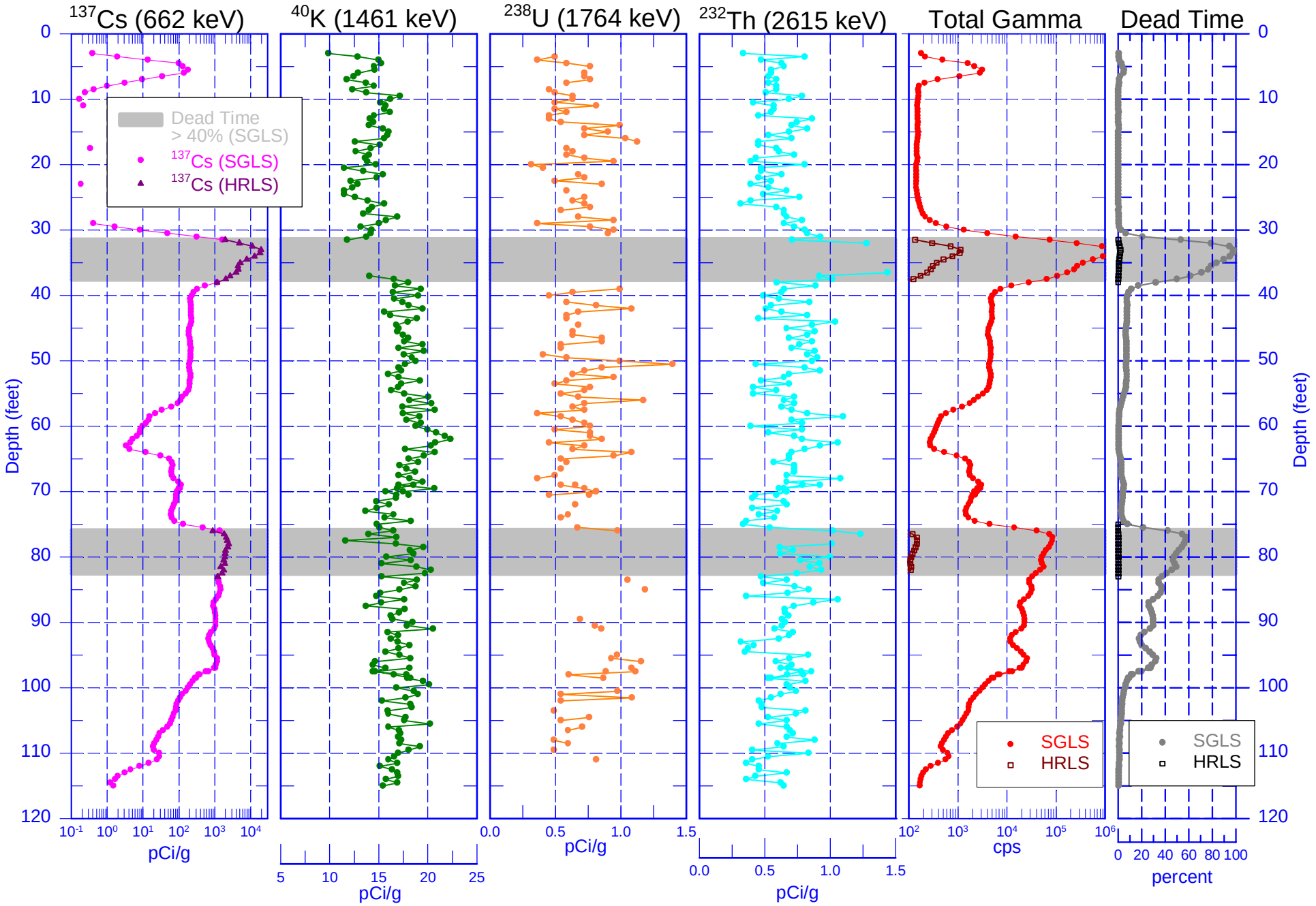
## Man-Made Radionuclides



# 299-E33-71 (A6879)
## Natural Gamma Logs



# 299-E33-71 (A6879) Combination Plot



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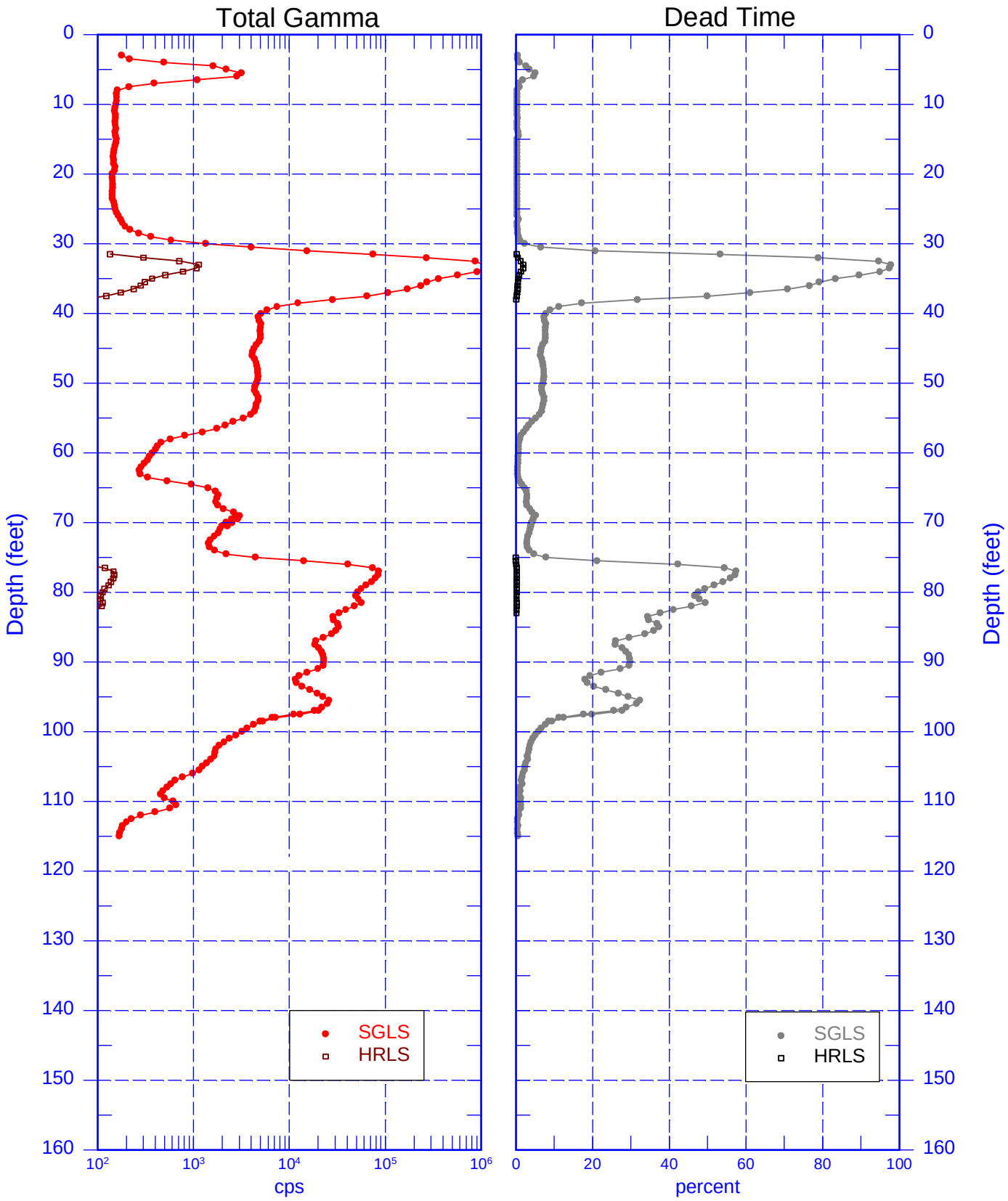
## Total Gamma & Dead Time



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## Repeat Section for Natural Gamma Logs